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ABSTRACT

This paper discusses how various educational inputs have changed in the last decade and examines the impact of those changes on per-pupil salary expenditures. Data for the study, which were obtained from the Missouri Department of Education, cover all certified personnel in St. Louis-area school districts between 1968 and 1976. Analysis of the data shows that teacher-pupil ratio, percentage of certified staff in nonteaching positions, and average level of teacher experience and training all increased during the period, and that these factors all contributed to increased per-pupil salary expenditures. The authors estimate that returning all three variables to 1968 levels could decrease the salary budget by 25 to 32 percent. The authors briefly review research findings on the relationship between student achievement and the three variables and conclude that it is doubtful whether the observed changes have contributed to improved student achievement. (Author/JG)

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THE INCREASING COST OF PUBLIC EDUCATION

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Abstract

Cost Increases of Urban Public Services:
The Case of Public Education

In this paper, we examine the factors which have caused salary expenditures per pupil to increase between 1968 and 1975. Our results indicate that the pupil-teacher ratio, the percent of staff in non-teaching positions, and the average level of total experience all affect expenditures in the expected direction. We estimate that a return to the 1968 levels of these variables could result in a savings of 25% to 32% of the salary budget. We also discuss the relationship between these key variables and student achievement, and suggest that districts may be decreasing their ability to produce achievement by making the changes they have during the time period.

Introduction

The cost of providing public elementary and secondary education has increased substantially in the past decade. There are many components of total cost, but the largest portion is accounted for by expenditures on teacher salaries and other certificated personnel [14]. As one example of this, the average district salary expenditure per pupil in the St. Louis metropolitan area increased from $390 in 1968 to $715 in 1975. This represents an increase of 83.3% over the eight year time period, or about 9% per year.

Our objective in this paper is to provide a partial explanation of why salary expenditures per pupil have increased so rapidly. We do this by examining some of the factors which affect this variable, and by employing regression analysis. Following that discussion is a speculative examination of some of the implications of the change in the inputs to the educational process.

The data employed in this study were obtained from the Missouri Department of Elementary and Secondary Education, and contain information on all active certified personnel in each school district in the St. Louis metropolitan area between 1968 and 1976. For the current study, the data have been aggregated to the school district level.

Changes to the Inputs in Schools

Aside from inflation, one major source of cost increases in public schools is from changes to the inputs used by the schools. There have been major changes to these inputs in the time period covered by our data. Although these changes have been major, they have taken place very quietly and are little understood by the educational community, let alone the general public.

The changes to which we refer have to do with the allocation of personnel in the schools. Because schooling is a labor-intensive industry, the changes are

potentially expensive. The three major changes we will discuss in more detail are:

1) a decrease in the number of students faced by each teacher, resulting in increased costs per pupil;
2) the teaching force, which is paid on the basis of some combination of training and experience, has become more experienced and more highly trained; and
3) more personnel have been allotted to staff roles in the schools, serving as counselors, program administrators, and other roles in the public school bureaucracy.

These are interesting changes, for unlike inflation, they are all at least partially amenable to manipulation by boards of education or superintendents who, if they choose to do so, could affect costs by changing some of these inputs.

In the following paragraphs, we give a brief description of changes in these variables, and in some others which are allied to them and which are also changing rapidly. We then proceed to show how the changes that we observe might be affecting the costs of education.

Table 1 summarizes changes in the key personnel-oriented inputs over time. The total student enrollment (STUD) in the area has declined from 364,603 in 1968 to 343,769 in 1975, which represents a decrease of approximately 6%. The number of teachers (TEA), however, has increased from 14,733 in 1968 to 16,285 in 1975 -- an increase of 11%. These changes have not been uniform around the metropolitan area. The districts close to the inner city have been net losers of up to 20% of their students, while the newer suburban districts have experienced enrollment increases of over 20%. The proportional changes in the size of the teaching staff are

somewhat smaller, although the trend remains in that the teaching staffs of inner districts have generally declined while in the suburban districts the teaching staff has increased dramatically. A more detailed analysis of these changes may be found in Anderson and Mark [1].

As a result of the decline in the number of students and the increase in the number of teachers, the pupil-teacher ratio (PUPTEA) has declined dramatically during the eight year period. In 1968, the average pupil-teacher ratio was 24.1, while in 1975, it was 20.3, a decrease of about 15%. Figure 1 provides a graph showing the consistent decline in this key variable.

INSERT FIGURE 1 HERE

As the number of students per teacher decreases, salary expenditures per pupil will tend to increase. Thus, we expect that PUPTEA will be a key variable in explaining the variation in salary expenditures per pupil.

There are a number of important variables which have direct and significant impacts on the level of teacher salaries, and therefore will likely be important determinants of salary expenditures per pupil. It is acknowledged the experience and training are the primary determinants of an individual's salary. From this, it follows that the average experience and training levels for a district will be important determinants of district salary expenditures per pupil. Figure 2 shows the trends in these two key variables as measured by total teaching experience (TOT) and number of graduate hours (GRADHR) for the period under analysis.

INSERT FIGURE 2 HERE

Total experience remains roughly constant during the time period under study. Our earlier results [1] indicate that teachers are remaining in the profession longer, and thus we might expect that TOT should increase over time. The observed constancy occurs primarily because the teaching staff has increased and the new additions tend to be inexperienced.

Figure 1

Trend in Pupil-Teacher Ratio
1968-1975

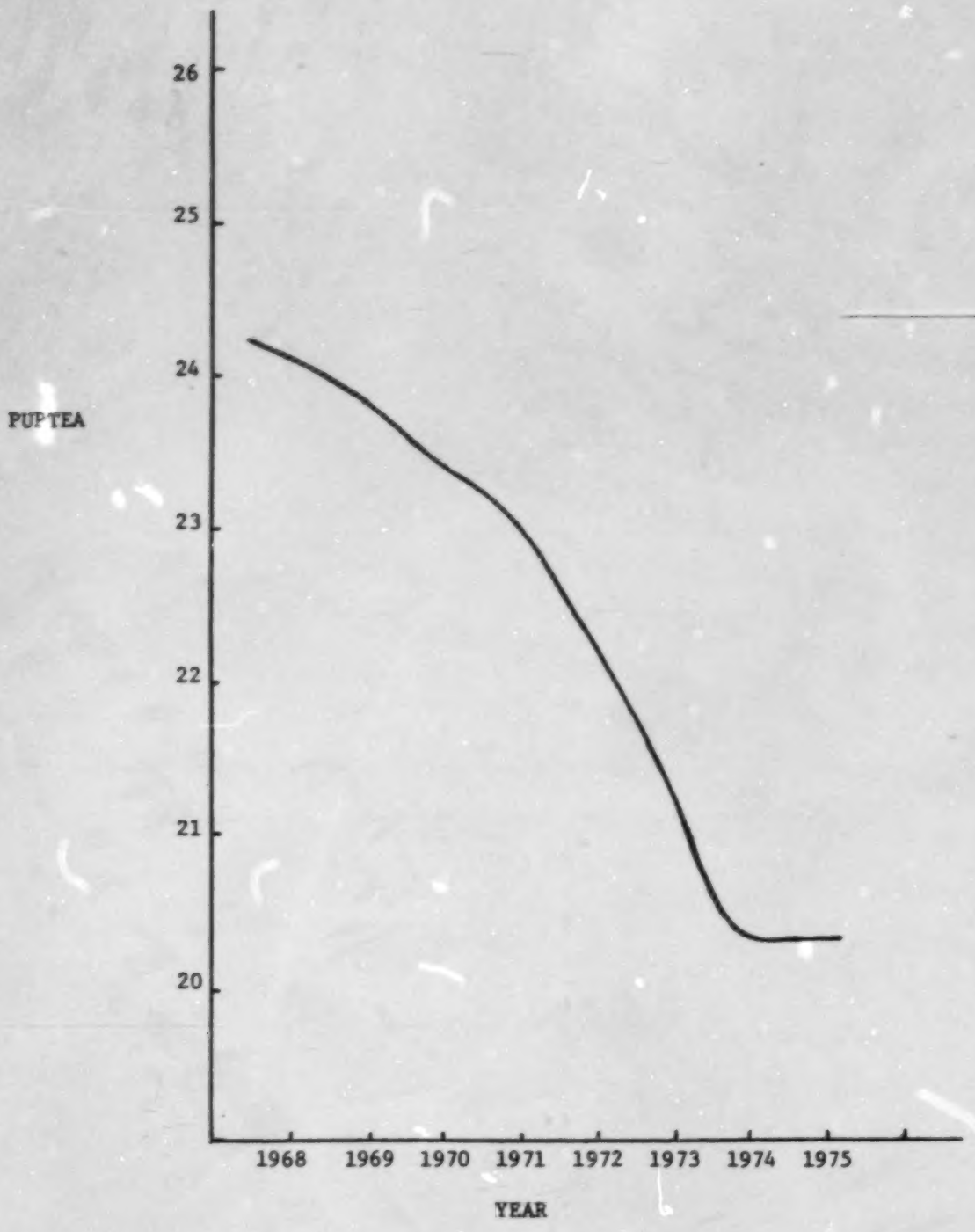
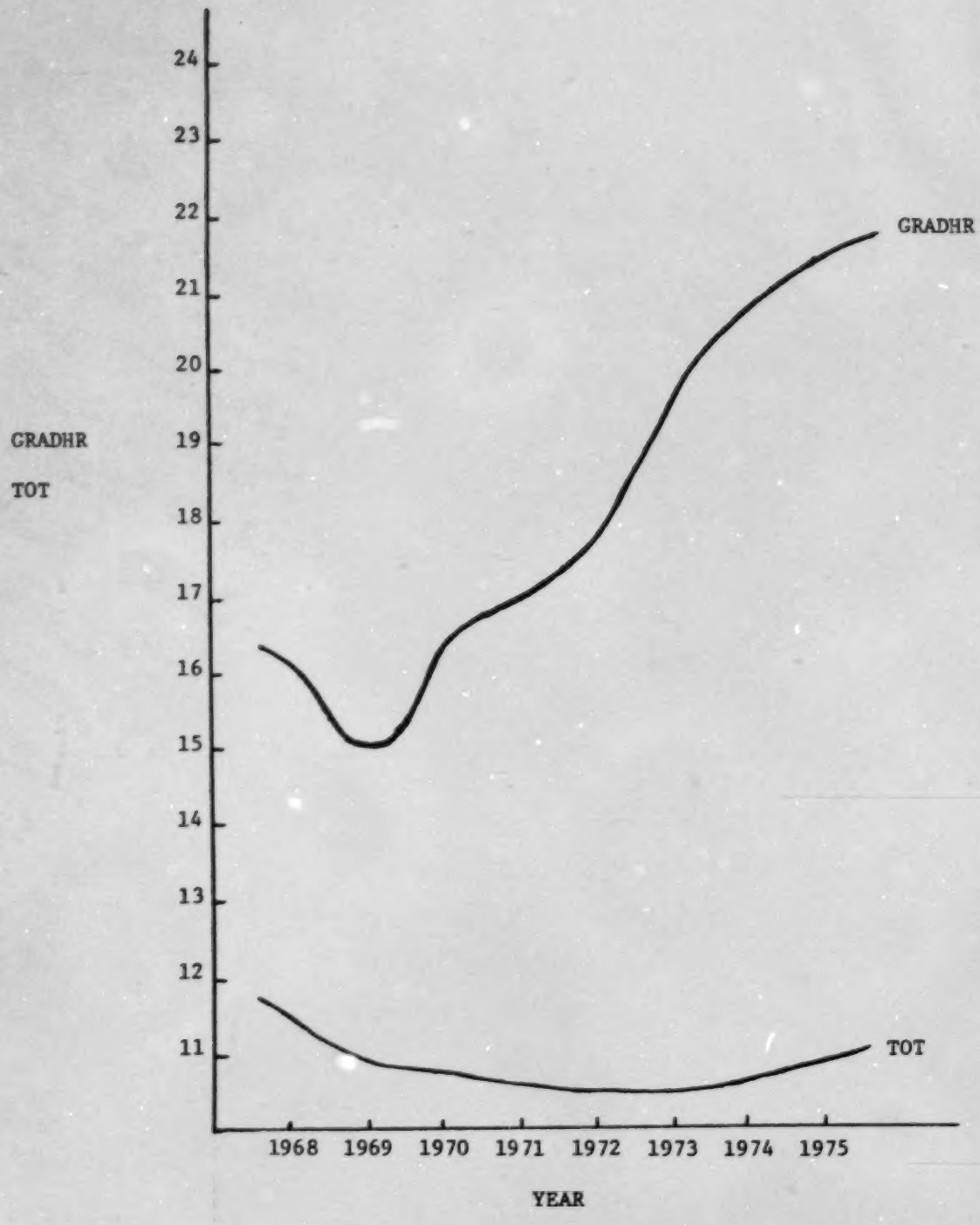


Figure 2

Trends in Total Experience and Graduate Hours
1968-1975



There is an important variable related to teacher experience that must be mentioned. Because experience is a primary determinant of salary, it follows that new entrants to the teaching profession will have relatively low salaries and thus tend to lower the average salary in a district. In 1968, 12.9% of the teachers in the metropolitan area were new to the profession. This proportion has dropped steadily, until in 1975, only 4.7% of the teaching force was new to the profession. This represents a decrease of 64%. As with the number of teachers and students, the changes in the distribution of new entrants to teaching is not constant around the metropolitan area. Figure 3 shows the trend graphically of PCNEW.

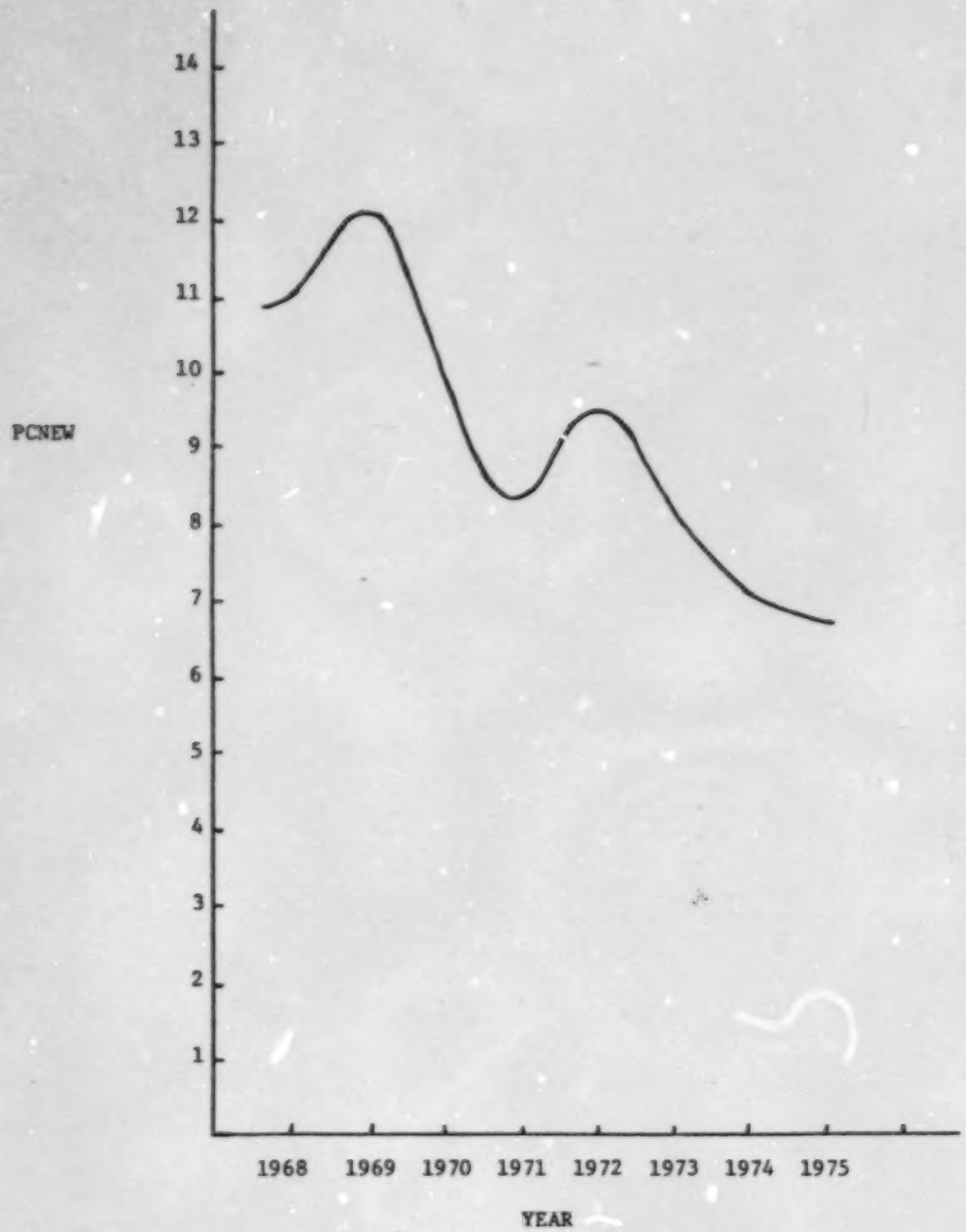
INSERT FIGURE 3 HERE

A third important set of variables potentially influencing the level of salary expenditure per pupil reflects the changing composition of the certified staff. As indicated in Table 1, the number of administrators (ADMIN) has increased substantially (about 38%) primarily due to a doubling of the number of student-oriented administrators (SADMIN). The number of administrators who directly administer teachers (TADMIN) has increased only slightly. The impact of these changes, however, is most noticed when we examine the relevant proportions and ratios.

While the number of teachers has increased by over 1500, their number as a fraction of the total certified staff has decreased from 88.5% to 86.0%. The proportion of the total staff who are student administrators has increased from 4.2% to 7.2%, while the proportion of the certified staff who are teacher administrators has decreased slightly. Figure 4 shows the decline in PCNONTEA, the proportion of the total staff who are in non-teaching (administrative) positions. We would expect that as the proportion of administrators increases (PCNONTEA) increases, salary expenditure would increase because administrators are more highly paid, and because administrators represent personnel who add to costs but who do not add to

Figure 3

Trend in Percent New Personnel
1968-1975



the teaching staff. (Also notable is the fact that the number of students per student administrator has decreased from 484 in 1968 to 233 in 1975).

INSERT FIGURE 4 HERE

One other factor which is likely to have a significant impact on salary expenditure per pupil is some measure of district growth. We would expect that districts suffering from declining enrollments would have relatively few new (and less expensive) teachers and would also suffer from temporary over-supplies of administrators. This situation is caused by an inability to adjust rapidly to declining enrollment. This suggests that declining districts will have higher salary expenditures per pupil, ceteris paribus, than would increasing districts.

The Model

We have considered several variables potentially related to salary expenditure per pupil; however, there are three primary ones. PUPTEA (pupil teacher ratio), TOT (average total experience), and PCNONTEA (proportion of staff in non-teaching positions) are all expected to be related to salary expenditure per pupil. Thus, we estimate

$$SALSTUD = a_0 + a_1\ PUPTEA + a_2\ TOT + a_3\ PCNONTEA + u. \qquad (1)$$

We expect that a_0, a_2 and a_3 will be positive, while a_1 should be negative.

Table 2 shows the correlation coefficients for these four variables for each of the eight years of our sample. The coefficients between SALSTUD and the three independent variables are consistent in their sign and agree with their predicted signs in (1) above. A comparison of the correlations among the independent variables with the multiple correlation coefficients for (1) suggest that multicollinearity is not a problem, according to the rule of thumb suggested by Farrar and Glauber [7].

Figure 4

Trend in Percent of Staff in Non-Teaching Positions

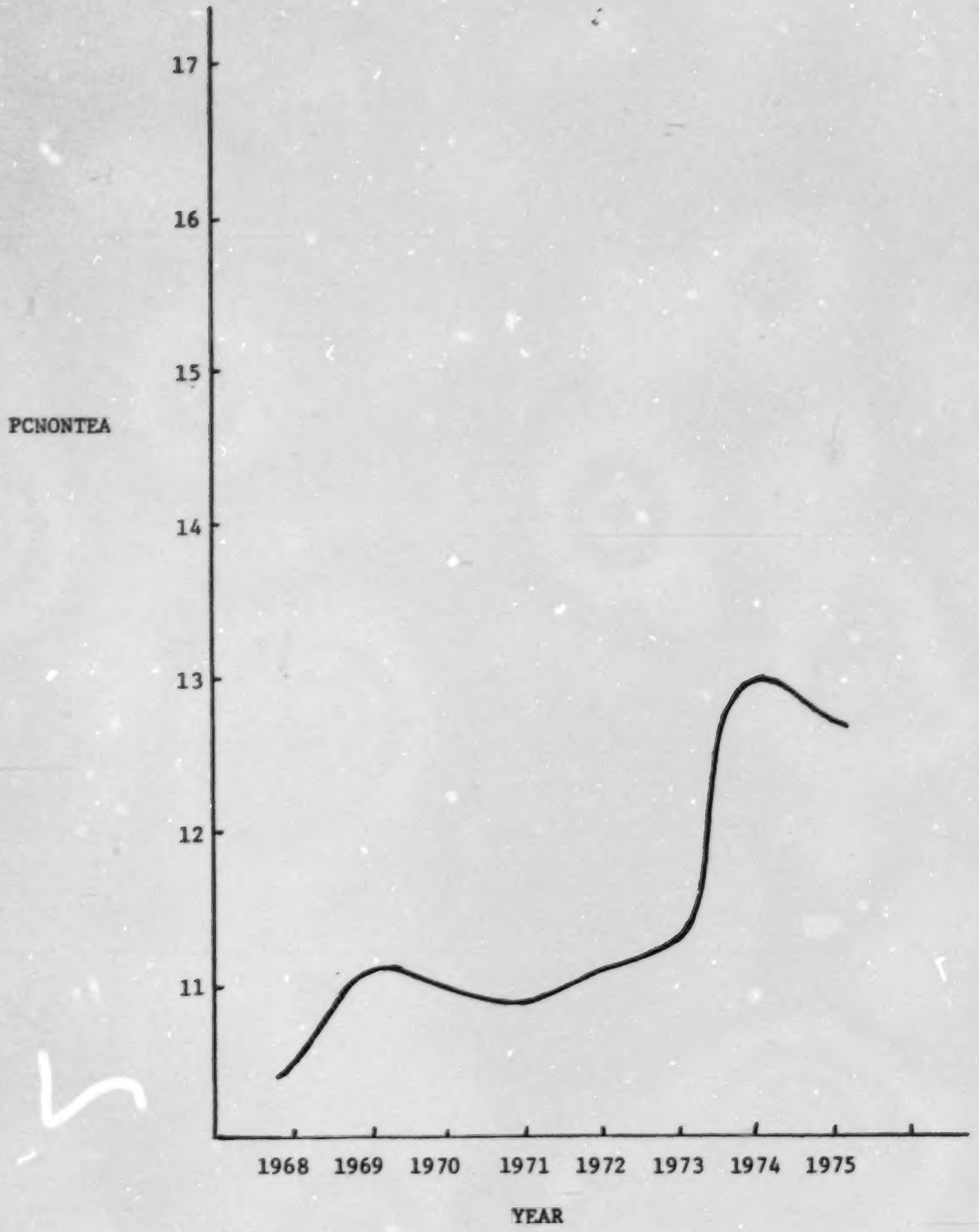


Table 3 shows the regression results obtained from estimating (1) for each year of data. There is only one case where the estimated sign is different than the expected sign (PCNONTEA in 1970), and in that case, the null hypothesis of no impact cannot be rejected. Of the other twenty three coefficients, all but two are significantly different from zero at the α=.01 level, while the other two are significantly different from zero at the α=.05 level. Given that there are only three independent variables, the R^2 values, which range between .70 and .83, are all quite high.

We have also estimated

$$RSALSTUD = a_0' + a_1' PUPTEA + a_2' TOT + a_3' PCNONTEA + v \qquad (1')$$

which is identical to (1) except that deflated salary expenditures per pupil is used in place of SALSTUD. SALSTUD is deflated to 1967 dollars by using the consumer price index. Econometrically, it must be that the coefficients of the independent variables in (1') are identical to those obtained by estimating (1), except that they will be deflated by the same deflation factor (the CPI) as is SALSTUD. Therefore, the pattern of signs and significance as detailed in Table 3 are replicated.

The results presented in Table 3 allow us to conclude that PUPTEA, TOT, and PCNONTEA do have a significant (and consistent) impact on salary expenditures per pupil. The functional importance of the results, however, is to allow us to predict what salary expenditures per pupil could be in 1975 if there was a return to the 1968 mean values of the independent variables. This predicted expenditure is obtained by applying the 1975 regression results to the 1968 values of the independent variables. When this is done, the predicted expenditure is $534, compared with an actual value of $715. This amounts to a savings of approximately 25% of the 1975 expenditure. Given that there were 343,769 students in 1975, the savings of $181 per student represents a total savings of approximately $62.2 million.

The figures above suggest that if every district returned to the 1968 means levels of the independent variables, then a savings of approximately 25% could be achieved. We have also calculated the savings that would be achieved if each district returned to its own rather than to the mean 1968 levels of the independent variables. The sum of the savings in each of the forty-five districts that existed in both 1968 and 1975 comes to about $78.6 million. This sum represents a savings of about 32%, as compared with 25% above.

The savings for each of the districts vary considerably. For two of the districts, the savings would be negative; that is, a return to 1968 levels would result in a higher salary expenditure per pupil than actually occurred in 1975. For the other districts, the savings are always positive and range from less than 1% to over 90%. In contrast to our earlier results concerning the distribution of enrollment and staff changes throughout the area, the distribution of savings seems to be random. Nor does there appear to be any relationship between actual 1975 expenditure and potential percentage savings.

These results are important in that they allow us to understand what factors affect the level of salary expenditures per pupil. We do not doubt that principals and superintendents have some notion about the direction and magnitude of impact on SALSTUD due to changes in pupil-teacher ratio experience levels and staff composition. Our results, however, provide somewhat more precise estimates of these impacts, and permit school officials to estimate the effects of certain cost reducing options which are open to them. In the next section, we discuss the relationship between these changes and the determinants of student achievement.

Implications

The question which should be addressed by school boards and taxpayers is whether or not the changes which have occurred since 1968 are worth their additional

cost of 62 to 78 million dollars. With regard to their impact on student achievement, the evidence is mixed concerning investment in small pupil-teacher ratios, large numbers of administrators, and more experienced and highly trained teachers.

Cohn [5] provides an excellent discussion of the educational process viewed in an input-output context. He correctly points out that there are both school and non-school inputs, as well as many outputs. Often considered inputs include pupil-teacher ratio, teacher quality, race, IQ, and family background, among many others. As far as outputs are concerned, there are only a few studies that consider outputs other than student achievement, such as the attainment of vocational skills, attitude adjustment, and high school dropout rates. Boardman et al. [3] conduct a simultaneous equation analysis examining six outputs, but this type of analysis is rare. Our concern here is with the results of those studies which focus on the school inputs to the educational process as they affect student achievement.*

The results of input-output studies as applied to the educational process are not conclusive for all of the relevant inputs. With regard to teacher experience, the Coleman report [6] found no significant impact on student achievement, while Katzman's [12] study found an inconclusive relationship. Goodman [8], Thomas [17], and Hanushek [9], [10] found, on the other hand, that teacher experience has a positive impact on achievement. Boardman et al., using a quadratic specification for experience, found that teachers with only a few years of experience ceteris paribus affect student achievement negatively, while more

*We acknowledge the fact that there is potential ambiguity surrounding the interpretation of achievement scores, however for the purposes of this paper, we accept achievement scores as some measure of value added.

experienced teachers have a positive impact on achievement. Cohn states that this is diametrically opposed to traditional thinking. Summers and Wolfe [16], studying elementary schools in Philadelphia, found that high achieving students do best with experienced teachers, while underachievers do best with inexperienced teachers. In the high school portion of their analysis, the impact of experience is mixed, and depends on the particular subject being taught. Further, Rosenshine [15] summarized the results of nine studies examining the relationship between experience and achievement and found that while the relationship was generally a positive one, it was not statistically significant. In Heim's [11] review of twenty-three studies, he found that only 57% of them found a significant relationship between teacher experience and student achievement.

Class size, which is often approximated by the pupil teacher ratio, is a school input which has long been believed to be an important determinant of achievement. The popular thinking is that the smaller is class size (or pupil teacher ratio), the higher will be student achievement. The empirical evidence, however, is not as supportive of the popular thinking as it might be. Kiesling [13], Bowles [14], and Boardman all estimated equations in which the coefficient on class size (or some proxy of it) is negative. Summers and Wolfe found class size to be important in elementary and high schools, but not in junior high schools. Travers [18] reports five studies in which class size makes no difference. Heim found in his review of twenty-three input-output studies that "there seems to be little evidence to suggest that, within fairly broad limits, class size (or its most often used proxy, teacher-pupil ratio) has any general effect upon cognitive or noncognitive school outputs."

Although there are many other important variables which potentially affect achievement, the last one we will discuss is the composition of staff. The findings of Coleman and Bidwell and Kasarda [2] suggest that an increasing presence of

administrators or pupil personnel has a negative impact on student achievement. Heim's review found that in most of the studies where it was tested for, the ratio of special staff (comparable to our SADMIN) to the number of students had no significant impact on student achievement.

We have not reviewed all of the input-output studies that have been done, nor have we criticized each one. However, these studies are representative of the existing literature. The conclusion that we reach is that there is certainly some question as to whether increased teacher experience, decreased pupil teacher ratio, and increased administrative presence have the expected positive impacts on student achievement.

In sum, the jury is still out in the case of these variables. Yet while these variables are under study, schools continue to spend large amounts of money to decrease class size, increase administrative services, and provide supplementary payments for training and experience. Some innovative administrator or school board might try and experiment here, perhaps by reducing the pecuniary return to training and experience, or by increasing, within limits, pupil teacher ratios. Further, more attention should be paid to the composition of the total certified staff, particularly with regard to administrator presence.

Table 1

TRENDS IN KEY VARIABLES, 1968 to 1975*

	SALSTUD	Deflated SALSTUD	STUD	TEA	PUPTEA	TOT	GRADHR	PCNEW	ADMIN	SADMIN	TADMIN	PCNONTEA	Number Distri
1968	389.82	374.11	364,603	14,733	24.1	11.5	16.1	11.0	1,919	697	1,222	10.5	48
1969	413.39	376.49	373,598	15,281	23.8	10.9	15.0	12.1	2,053	848	1,205	11.1	53
1970	458.96	394.64	376,490	15,809	23.4	10.8	16.4	10.0	2,107	899	1,208	11.0	53
1971	493.69	407.00	363,012	16,298	23.3	10.6	17.0	8.3	2,207	985	1,222	10.9	53
1972	535.87	427.67	366,245	16,684	22.2	10.5	17.8	9.5	2,382	1,053	1,329	11.1	53
1973	591.15	444.14	361,771	16,430	21.2	10.5	19.7	8.2	2,397	1,059	1,338	11.3	52
1974	664.64	449.99	353,443	16,471	20.3	10.6	20.8	7.1	2,852	1,534	1,318	13.0	52
1975	714.72	443.38	343,769	16,285	20.3	10.9	21.5	6.8	2,648	1,355	1,293	12.7	50

*ratios and percents are the mean values for all districts

Table 2

SAMPLE CORRELATION COEFFICIENTS

	SALSTUD and PUPTEA	SALSTUD and TOT	SALSTUD and PCNONTEA	PUPTEA and TOT	PUPTEA and PCNONTEA	TOT and PCNONTEA
1968	-.84	.43	.64	-.23	-.52	.44
1969	-.77	.53	.20	.43	.05	-.02
1970	-.84	.50	.20	-.23	-.13	.54
1971	-.81	.59	.23	-.44	.07	.30
1972	-.74	.68	.26	-.54	.22	.23
1973	-.79	.64	.37	-.31	-.08	.34
1974	-.72	.66	.48	-.23	-.24	.42
1975	-.67	.70	.41	-.24	.05	.43

Table 3

Regression Results
Dependent Variable: Salary Expenditure Per Pupil

YEAR	CONSTANT	PUPTEA	PCNONTEA	TOT	R^2
1968	779.26	-25.66**	11.78**	9.21**	.80
1969	829.56	-26.67**	7.90**	11.99**	.70
1970	1048.80	-32.59**	-3.36	19.34**	.78
1971	943.45	-30.76**	11.80**	12.18**	.77
1972	820.20	-29.10**	20.23**	12.98*	.75
1973	980.02	-36.37**	12.35**	23.23**	.83
1974	1018.36	-38.94**	8.63*	30.63**	.79
1975	1059.55	-44.51**	14.95*	34.05**	.80

* t-value greater than 1.65 (significant at α=.05, one-tailed test)

** t-value greater than 2.33 (significant at α=.01, one-tailed test)

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